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Original Article Research

Minimizing level of oksidative stress in martial arts atlhetes

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Abstract

This research seeks to assess the impact of consuming fruit with high antioxidant content on reducing stress levels in martial arts athletes. The study employed an experimental approach with 18 trials, utilizing a pretest-posttest control group design within a true experimental laboratory framework. The sample consisted of 20 martial arts athletes, who were divided into two groups: a control group and an experimental group (which consumed fruit with high antioxidant levels). Data was collected by drawing blood from the cubital vein, which was then analyzed in the laboratory to measure MDA levels using the TBARS method. The data analysis process involved three steps: normality testing, homogeneity testing, and hypothesis testing. The study's findings indicate that fruit with high antioxidant content is effective in reducing stress levels among martial arts athletes.

Keywords: Fruit with high levels of antioxidants, stress levels, in martial arts atlhetes

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1. INTRODUCTION

Martial arts is a type of combat sport and is hard, it involves the whole body directly to attack and defend against attacks from opponents without any barriers (Andrea Putri et al., 2024). Martial arts consist of several sports, namely wrestling, pencak silat, kempo, boxing, sambo, taekwondo, sumo, wushu and karate. Martial arts have movements that emphasize agility, flexibility and speed. However, athletes often experience decreased stamina when training or competing which causes stress levels in a short time. Athletes with good nutritional status can contribute to athlete performance so that they can increase an athlete's productivity. The free radical scavenging activity of antioxidants is related to their antioxidant content. The higher the antioxidant content, the higher the antioxidant activity (Samh, 2013:48). Antioxidant content can neutralize free radicals through high antioxidant activity, so that it can prevent the onset of various diseases (Samichah & Syauqy, 2014). Natural antioxidants can increase antioxidant activity through the use of food (Getoff, 2007).

Athletes who exercise excessively can have a negative impact, namely causing an imbalance between reactive oxygen species (ROS) and antioxidants which ends in fatigue (Alessio et al., 2000), however, when athletes exercise there is a process of increasing the formation of oxidant compounds which is followed by the occurrence of oxidative stress (Harjanto, 2003 (at Heza Fuad Noor et al., 2020). Oxidative stress occurs in athletes during exercise because there is a balance between the production of oxidants and antioxidants (Leeuwenburgh & Heinecke, 2001). So you need to pay attention to vitamin intake in athletes, most athletes get enough vitamins. However, some athletes do not get optimal vitamin intake from food. In addition, certain athletes who participate in weight loss programs to qualify for competitions or improve performance do not receive adequate vitamin intake.

Free radicals are produced in the body as a result of oxidation and combustion processes in cells, which occur during respiration, cellular metabolism, intense physical activity, inflammation, and exposure to external pollutants such as cigarette smoke, vehicle exhaust, heavy metals, food contaminants, industrial chemicals, and ultraviolet radiation. The most common free radical formed in the body is superoxide, which is then converted into hydrogen peroxide (H2O2). Hydrogen peroxide, in turn, is transformed into hydroxyl radicals (*OH). These hydroxyl radicals lead to lipid peroxidation in the cell membrane, causing cellular damage. If this condition persists, it results in an imbalance between free radicals and endogenous antioxidants, a phenomenon known as oxidative stress (Iga Maharani et al., 2021).

Commonly consumed natural food ingredients, easily obtained and containing antioxidant compounds of vegetables and fruits. Fruits and vegetables are sources of natural antioxidants containing vitamins A, C, E, Beta carotene, carotenoids, flavonoids, and phenols (Samichah & Syauqy, 2014). Many types of fruits and vegetables contain high levels of vitamin C. Fruits contain a lot of vitamin C which functions as a natural antioxidant. Fruits have chemical content in the form of minerals, iron, and vitamin C, and have the potential as antioxidants needed by the body. Vitamin C can prevent oxidation of lipids, proteins, and DNA in the body which can cause mutations (Widyaningsih et al., 2016). It also plays a key role in shielding the body from reactive oxygen species (free radicals) and aids in regenerating oxidized vitamin E to its active form. At a certain point, oxidized vitamin C can be replenished by glutathione peroxidase, which contains selenium. Alpha-lipoic acid also helps restore vitamins C and E while protecting glutathione. the recommended daily intake of vitamin C is 75 mg for women and 95 mg for men. as a polar and volatile compound vitamin C is essential for safeguarding cells and tissues from oxidative stress induced by free radical exposure.

The formation of free radicals can be seen in the presence of Malonedialdehyde (MDA) levels, especially when carrying out high-intensity physical activity. Martial artists who do routine training can result in the formation of more Malonedialdehyde (MDA) compared to low-intensity training (Güzel et al., 2007). (George et al., 2009) said that oxidative stress increases when doing heavy training. MDA is the result of lipid peroxidation in the body due to free radicals (Wayan Eka Rahayu Dewi et al., 2018). MDA is a commonly used marker for free radicals (Ambardini et al., 2005). Free radicals in the human body can lead to oxidative damage, and elevated levels of MDA can result in the deterioration or degeneration of body cells. Consuming antioxidants can help prevent or counteract this cellular degeneration.

Meeting the recommended vitamin C intake for both men and women can be achieved by consuming fruit juices that are rich in vitamin C and high in antioxidant compounds. Eating fruit helps boost the body's intake of antioxidants. Fruits contain various antioxidant compounds, including betalains, phenolics, gallic acid, and betacyanins. Betalains, in particular, have antioxidant properties that help reduce oxidative processes (Glangkarn, 2015). he betalain extracted from fruits is safe for consumption and functions as a micronutrient in the body (Khan, 2016).

So far, the impact of regular physical exercise on the formation of free radicals in martial arts athletes is unknown, so further research is needed on the impact of regular exercise on the formation of free radicals and exposure to antioxidants contained in fruits with high antioxidants. Based on these problems, the author intends to conduct research on efforts to minimize the level of oxidative stress in martial arts athletes.

2. METHOD

This study is an experimental research using testing techniques for data collection. Experimental design is a type of experimental research, as it allows the researcher to control all external variables that could affect the experiment. This ensures that the internal validity (the quality of the research design) remains high. A key feature of true experimental research is that the samples used for experiments or as control groups are randomly selected from a specific population. Therefore, this design includes both a control group and a randomly chosen sample. In this study, the researcher aimed to assess the impact of antioxidant-rich fruits on stress. The research follows a true experimental laboratory design and employs a pretest-posttest control group approach.

2.1 Participants

The sample in this study was 20 martial arts athlete The sample selection for this study had to meet the criteria, namely male gender, 19-27 years old, not smoking or drinking alcohol, having been practicing for at least 6 months, practicing at least 3 times in 1 week. Establishing specific criteria for research subjects ensures an accurate depiction of the effects of the variables (Cipryan, 2017). Calculation of the sample size in this research involves Standard Deviation (SD) and the number of samples (n) from previous research. The researcher took the research sample size sampling technique from (Popovic et al., 2015) with the title "Influence of vitamin C supplementation on oxidative stress and neutrophil inflammatory response in acute and regular exercise". The standard deviation (SD) of the study was 0.97 for the control group and 1.48 for the treatment group. The method for dividing the sample groups is that they are selected randomly using a lottery and divided into 2 groups, namely the control group and the treatment group.

2.2 Research Design

This study used a true experimental laboratories approach, specifically the pre-test and post-test control group design approach, to investigate the efficiency of high-oxidant fruits to minimize oxidative stress levels in martial arts athletes. This experimental method was chosen based on the main objective of the study: comparing the effectiveness of this integrated approach with high-oxidant fruits to minimize oxidative stress levels in martial arts athletes with martial arts athletes who were not given high-oxidant fruits to minimize oxidative stress levels. The experimental group was given high-oxidant fruits to minimize oxidative stress levels in martial arts athletes, while the control group was athletes who were not given high-oxidant fruits to minimize oxidative stress levels. The intervention was given for 3 months.

2.3 Instruments

In this study, data were collected by drawing blood from the antecubital vein of the sample. The blood samples were then transported to the laboratory, where malondialdehyde (MDA) levels were measured for the control group and treatment groups I and II using the TBARS method. TBARS is one of the earliest indicators of lipid peroxidation used in studies involving human participants or experimental animals. The measurement process employs a spectrophotometer, which detects the absorption of color produced by the reaction between TBA and MDA (Winarsi, 2007). The instruments in this research include measuring MDA using the thiobarbituric acid reactive substance (TBARS) method:

1. Specimen: EDTA blood
2. Centrifuge: Brand: Heracus (Series: Biofuge 15)
3. Spectrophotometer: Brand: Hach (Series: DR /2000)
4. Column: Sep – Mr L 18.

2.4 Procedures

In this study, data were gathered by drawing blood from the antecubital vein of the participants. The blood samples were then sent to the laboratory to assess malondialdehyde (MDA) levels in the control group and treatment groups I and II using the TBARS method. TBARS is one of the earliest and most commonly used indicators of lipid peroxidation in research involving human subjects or animals. The measurement process employs a spectrophotometer that detects the color absorption produced by the reaction between TBA (thiobarbituric acid) and MDA (Winarsi, 2007). MDA is a highly reactive compound and the final product of lipid peroxidation, commonly used as a biomarker to evaluate oxidative stress (De Zwart et al., 1998). The widely applied method for MDA analysis involves a reaction in which one MDA molecule reacts with two TBA molecules to form TBARS (thiobarbituric acid reactive substances) (A, 1996).

2.5 Data Analysis

The data analysis method employed in this study involved hypothesis testing using a T-test for two correlated samples, conducted with SPSS 16.0 for Windows Evaluation Version, applying the Paired Sample T-Test formula. The Paired Sample T-Test consists of three stages: a) **Normality testing**, performed using the Kolmogorov–Smirnov test. The distribution is considered normal if $p > 0.05$ (5%), and abnormal if $p < 0.05$ (5%). b) In addition to testing the data distribution, a **homogeneity test** is necessary to ensure that the groups forming the sample are from a homogeneous population. This test is carried out using Levene's statistics via one-way ANOVA. The criteria for homogeneity are $p > 0.05$ and F count < F critical value, indicating homogeneity, whereas $p < 0.05$ and F count > F critical value suggest inhomogeneity. c) **Hypothesis testing** is conducted to evaluate the hypothesis based on the data, determining whether the null hypothesis (H0) should be rejected or accepted by comparing the calculated t value with the critical t value. The T-test is performed to determine whether there are differences between the pretest and posttest variables in the experimental group. In this study, a paired sample t-test was used. If the significance value is less than 0.05 ($P < 0.05$), it indicates a significant difference. The data from the pretest and posttest are analyzed using descriptive statistics with the t-test via the SPSS software, with a significance level of 5% (0.05). This t-test assesses whether consuming fruits high in antioxidants has an effect on reducing MDA levels.

3. RESULTS

3.1 Data Description

The research sample consisted of twenty people, the sample in this study was martial arts athlete who were divided into 2 groups, namely the treatment group and the control group. Each group consisted of 10 athletes and all research samples were male. The age of the research sample was between 18 – 28 years and were martial arts athletes or people who had been trained (more than 6 months).

Table 1

Data Description

Group	N	Age	Body Weight (Kg)	Height Measurements (cm)	*Body Mass Index* (BMI)
Treatment	10	22.30±2.1	63.70±3.68	63.70±3.68	22.57±1.16
Control	10	23.40±2.8	63.20±4.87	63.20±4.87	22.40±1.49

The data shows that the average age of the treatment group was 22.30 ± 2.1 years, while in the control group the average age of the sample was 23.40 ± 2.8 years. Existing age data states that the research subjects are at the peak of their performance. The average body weight of the control group was 63.70 ± 3.68 kilograms, and in the treatment group the average body weight was 63.20 ± 4.87 kilograms. The weight data in the research results obtained during the research stated that the research subjects were neither obese nor underweight. Height measurements that were carried out showed that the average height of the control group was 168.20 ± 1,687 centimeters. Meanwhile, in the treatment group the average height obtained was 167.90 ± 1,792 centimeters. The height of the research subjects was in ideal conditions in accordance with the average height of Asian people in general. The average Body Mass Index (BMI) in the 2 groups of research subjects was 22.57 ± 1.16 in the control group and 22.40 ± 1.49 in the treatment group. The average BMI results in this group show a condition where the research subjects are in normal condition, not overweight or too thin.

3.2 *Malonedyaldehyd* (MDA)

MDA data was obtained through pre-test and post-test, namely before the sample received treatment and after receiving treatment. MDA data was obtained using the T-BARS test on blood. The average MDA results for the entire sample can be seen in the following table.

Table 2

Malonedyaldehyd (MDA)

Group	Malonedyaldehyde (nmol/ml)		Percentage Decrease
	Pre-Test	Post-Test	$\overline{X}$ % Δ
Treatment	2,90±0,84	2,37±0,92	-18%
Control	3,48±0,97	3,15±0,82	-9%

The table shows the pre-test and post-test MDA data in 2 groups. The average pre-test results in each group were 2.9 ± 0.84 and 3.48 ± 0.97 nmol / ml, while the average post-test results in each group were 2.37 ± 0.92 and 3.15 ± 0.82 nmol / ml. The posttest of the 2 groups showed a decrease of 18% in the treatment group and a decrease of 9% in the control group. The decrease in MDA levels in both groups of research subjects decreased, but the provision of fruit with high levels of antioxidants consumption given to the treatment group reduced MDA levels better, because the decrease in MDA levels was known to be 2 times greater than the control group.

3.3 Normality and Homogeneity Test

Normality and homogeneity tests are essential preliminary tests for conducting hypothesis testing. In this study, the normality test is performed using the Kolmogorov-Smirnov and Shapiro-Wilk tests, while the homogeneity test is conducted using Levene's Statistic.

Table 3

Normality Test

Group	Test	Sig
Treatment	Pretest	0.119
	Posttest	0.200
Control	Pretest	0.200
	Posttest	0.200

Table 4

Homogeneity Test

Group	Levene Statistic	df 1	df 2	Sig.
Treatment	.125	1	18	.735
Control	.068	1	18	.789

Table 3 shows that the significance value of the pretest data in the treatment group is 0.119 > 0.05 and the posttest is 0.200 > 0.05, indicating that the data is normally distributed. Similarly, in the control group, the significance value of the pretest is 0.200 > 0.05 and the posttest is 0.200 > 0.05, suggesting a normal data distribution as well. Since the significance values for both groups are > 0.05, it can be concluded that the test conducted between the pretest and posttest values for each research group is normally distributed.

Table 4 explains that the data from the treatment group has a significance value of 0.735 > 0.05, indicating that the data is homogeneous. In the control group, the significance value is 0.789 > 0.05, also indicating homogeneity. The data from both groups are considered homogeneous because the significance values for both are greater than 0.05.

3.4 *Paired Samples Test*

Table 5. Paired Samples Test

Variable	Group	Test	$\overline{X}$ Δ±SD	Sig
MDA	Treatment	Pre	0.55±0.20	0.35
		Post		
	Control	Pre	0.30±0.38	0.32
		Post		

The data in table 5 shows that there is a difference in the results between the post-test and pre-test in the control group with a significance value of 0.035 <0.05. While the difference in the results between the post-test and pre-test in the treatment group with a significance value of 0.032 <0.05. Table 8 also shows the results of the average decrease in each group of research samples. The average decrease in the results of the mda test in the treatment group was 0.55 ± 0.20 and the average decrease in mda in the control group was 0.30 ± 0.38. The average difference in the decrease in the treatment group in the table is greater than the control group, this indicates that giving fruit with high levels of antioxidants is effective in reducing MDA in the body.

Table 6. *Independent Samples Test Post-test*

Group	$\overline{X}$ Δ	SD	Sig.
Control	0.867	0.935	0.593
Treatment	0.867	0.957	

The data presented in Table 6 indicates that the significance value between the treatment group and the control group is greater than 0.05, with a significance value of 0.593. This suggests that there is no significant difference in the effect or influence between the two groups. Meanwhile, the results in Table 10 reveal that both groups of research subjects experienced a decrease in MDA levels in the blood.

4. DISCUSSIONS

The focus of this research is to determine the effect of fruits containing high antioxidants on reducing stress levels in martial arts athletes. Furthermore, a diet richer in antioxidants may help control oxidative status in soccer players and physically active people by reducing the formation of F2a-IP (Zare et al., 2024). Fruit is one of the sources of natural ingredients that contain high anti-oxidant compounds. Exercise can affect the increase in malondialdehyde (MDA) levels and by consuming fruit, the increase in MDA levels can be prevented and can even reduce MDA levels as the main precursor of high levels of free radicals. Another debated topic concerning exercise-induced oxidative stress is the notion that free radicals produced during physical activity may function as a form of hormesis, stimulating key elements of the body's endogenous antioxidant defense system, such as superoxide dismutase and glutathione peroxidase. In other words, moderate exercise, which is not overly strenuous, could potentially serve as an effective natural antioxidant (Ji, 2002; Yavari et al., 2015) Compared to synthetic antioxidants, the natural anti-oxidants contained in fruit are considered safer for consumption, so they can improve the body's health status. Of the eight countries, Indonesia is one of the countries that has a variety of tropical plants, one of which is tropical fruit plants which contain high natural antioxidant content (Febrianti et al., 2015).

Consumption of fruit with high levels of antioxidants in this study has been shown to reduce MDA levels in martial arts athletes. The role of antioxidants from the vitamin group (exogenous) is to slowing or preventing damage to body cells as a result of exposure to compounds free radicals, whether they come from consuming unhealthy foods or as a result of oxidative stress at the cellular level(Heza Fuad Noor et al., 2020). The findings of this study are consistent with previous research, which suggests that fruits with high antioxidant levels can help reduce free radical levels in the body. Such fruits are rich in phenolic compounds in their pulp, which act as antioxidants and can inhibit melanoma cell growth (Wu et al., 2006). In addition to phenolics, fruits high in antioxidants also contain abundant amounts of nutrients like Vitamin C, B2, B3, and triamine, all of which contribute to reducing free radical levels. Vitamin C, in particular, plays a crucial role in neutralizing exogenous free radicals (those from external sources). Vitamin C is a water-soluble antioxidant that effectively neutralizes superoxide, hydroxyl, and lipid hydroperoxide radicals, playing a crucial role in regenerating vitamin E in cell membranes during oxidative stress (Kojo, 2004) (Yavari et al., 2015). In this study, the vitamin C content in fruit serves as a positive control, as it is recognized as a primary antioxidant. The ascorbic compounds in vitamin C help suppress the increase of reactive oxygen species (ROS) and terminate the oxidative chain outside the nucleus. Vitamin C, with the chemical formula $C_6H_8O_6$, contains a six-carbon lactone ring structure. It is synthesized from glucose in the liver of mammals; however, humans, primates, and guinea pigs are unable to produce it due to the lack of the enzyme gulonolactone oxidase and the absence of the genetic code required for its synthesis (Febrianti et al., 2015). Ascorbic acid is highly soluble in water and is easily broken down. Its solubility in water is 33 g/100 ml.

Ascorbic acid plays a vital role in stimulating the synthesis of type IV collagen, enhancing endothelial cell proliferation, reducing LDL oxidation, and providing increased protection against substances that induce oxidative stress. In addition to its role as an extracellular protector against oxidative damage, vitamin C functions as an electron donor and reducing agent, facilitated by the double bond between C-2 and C-3 in its six-carbon lactone ring. Furthermore, ascorbic acid serves as a coenzyme and electron donor in various organic enzymatic reactions, contributing to the synthesis of neurotransmitters, peptide hormones, noradrenaline, cholesterol, and amino acids in the body (Aguirre & May, 2008).

The research you mentioned indicates that consuming 200 mg of vitamin C, which is contained in fruit with high antioxidant content, can reduce Malondialdehyde (MDA) levels by 18%, which is an indicator of oxidative stress. Apart from reducing MDA, this study also highlights other effects that occur after consuming vitamin C. One important finding is a decrease in the production of Reactive Oxygen and Nitrogen Species (RONS) in individuals who do sports or exercise at high intensity. RONS, although they can function physiologically in various body processes such as immunity, cellular signaling pathways, and mitogenic responses, can pose a risk of causing cell damage if produced in high concentrations. At low to moderate concentrations, RONS has a beneficial role, but it needs to be maintained so as not to overdo it. In addition, this research also shows that high-intensity physical exercise is associated with an increase in the body's endogenous antioxidant capacity, which functions to fight oxidative stress. The body's total antioxidant capacity (TAC) can increase with increasing exercise intensity. This shows a direct relationship between exercise intensity and strengthening the body's defense system against oxidation. Overall, consumption of antioxidants such as vitamin C, coupled with exercise, can help maintain a balance between the production of beneficial RONS and maintaining the body's ability to fight oxidative stress (Cipryan, 2017).

Increased Total Antioxidant Capacity (TAC) in physically trained individuals may contribute to better changes in redox homeostasis, leading to greater health benefits. Redox homeostasis refers to the balance between the production of Reactive Oxygen Species (ROS) and the body's ability to overcome oxidation through the antioxidant system. An increase in TAC indicates that the body can more effectively fight oxidative stress caused by physical activity (Cipryan, 2017). The decrease in stress levels marked by a decrease in MDA levels in the blood of the study subjects can be said to be no different. The level of significance of the results of this study proves that there is no significant difference in the decrease in the 2 groups of study subjects with a significance level value of 0.781> 0.05.

5. CONCLUSIONS

Providing fruit with high levels of antioxidants can minimize stress levels in martial arts athletes. Although this research proves that consumption of fruit that has high levels of antioxidants has been proven to reduce MDA levels, stricter control is needed in selecting fruit quality, so that the content of dragon fruit can be optimized to break the chain of oxidative stress.

Although this research proves that consumption of dragon fruit has been shown to reduce MDA levels, tighter control is needed in the selection of dragon fruit, so that the contents of dragon fruit can be optimized to break the chain of oxidative stress.

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